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Abstract

THE HISTORY OF THE MAJOR PULSES OF TRITIUM IN THE STRATOSPHERE

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In recent years there have been several periods during which substantial amounts of tritium were released at high atmospheric levels, more precisely, in stratospheric regions. Most of this tritium is transformed fairly rapidly into tritiated water, HTO, and will be found, sooner or later, in the various forms of water on our planet. By investigating the abundance of tritium in various natural waters at various times one can assess what can be called the history of these pulses; the history in the sense of a study of where, when and at what concentrations the tritium is appearing. This history, of course, depends strongly on the pattern of the circulation of water in nature. The history of tritium pulses in the sense given above will be a synthesis of all processes which transport the tritium horizontally in the stratosphere and in the troposphere and vertically down to the ground, and of all processes which transport tritium along the earth's surface underground, in lakes and rivers, and, finally, of all processes which transport tritium into the depths of the ocean, the final recluse for this man-made tritium.

Because all processes which are responsible for the transport of tritium in nature can be regarded as quasi-stationary when suitable time-scales are chosen, the history of the tritium pulses contains unique information about these processes. The transports can be expressed in various ways, sometimes they can be specified in terms of vector quantities, sometimes in terms of turnover times and residence times. The amount of information which can be extracted depends simply on how detailed the history of the tritium pulses is known and what auxiliary information is available.

For the study of the history of man-made tritium, observations both in space and time are needed. A beginning has been made on a global scale through the organization of a world-wide network for collection of monthly samples of precipitation and subsequent analyses, a joint IAEA/WMO project in which a number of laboratories take part. A similar network for river waters is needed to follow up the part of the tritium history of fresh waters. Locally, groundwater investigations on tritium are being made. But even if sufficient observation points exist the tritium history has a fourth dimension, time, and observations have to go on for a time period comparable to at least two half-lives of the tritium atom, in order to extract as much information as possible.

From meteorological point of view tritium data on precipitation makes it possible to estimate stratospheric residence times, hemispherical mixing and water vapour transport patterns over continents. In hydrology discussions of continental water balances have been made from tritium data in precipitation and river waters as well as characteristics of smaller catchment areas. The water budget of soil profiles and plants was discussed successfully recently from data on tritium in ground water, soil water, plant water and precipitation. Underground storage of water has been investigated frequently in the past.

For interpretation of tritium data information on the stable isotopes, deuterium or oxygen-18 in water is sometimes most useful.